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DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ARITHMETIC.

156. Proposed by JAMES F. LAWRENCE, A. B., Professor of Mathematics, Rogers Academy, Rogers, Ark.

Suppose that in a meadow the grass is of uniform quality and growth, and that 6 oxen or 10 colts could eat up 3 acres of pasture in 18-25 of the time in which 10 oxen and 6 colts could eat up 8 acres; or that 660 sheep would require 2 6-7 weeks longer than 660 sheep to eat 9 acres. In what time could 1 ox, 1 colt and 1 sheep eat up 1 acre of pasture, on the supposition that 588 sheep eat as much in a week as 6 oxen and 11 colts?

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics in The Temple College, Philadelphia, Pa.

Let the standing grass on one acre be denoted by 1, and the weekly growth on one acre by u . From the first condition: Because 6 oxen eat all that grows on 3 acres each week and in addition $25/18t$ part of the grass standing on 3 acres; and because 1 colt eats $\frac{3}{8}$ times as much as 1 ox, we have what 1 ox eats in 1 week $= \frac{1}{6}(3 \times \frac{25}{18t} + 3u) = \frac{1}{36t}(25 + 18tu) \dots (1)$, what 1 colt eats in 1 week $= \frac{1}{60t}(25 + 18tu) \dots (2)$.

From the second condition we have: What 10 oxen and 6 colts eat in 1 week $= 8/t + 8u \dots (3)$. We have considered $\frac{1}{2}\frac{8}{5}t$ weeks in first condition, and t weeks in second condition as the time required.

From (1), (2), (3), we have $\frac{1}{90t}(25 + 9)(25 + 18tu) = \frac{8}{t}(1 + tu)$, or $(25 + 9)(25 + 18tu) = 720(1 + tu) = 34(25 + 18tu) \dots (4)$.

Suppose that 9 acres will support 660 sheep for x weeks; then 1 sheep in 1 week will eat $\frac{3}{220x}(1 + ux) \dots (5)$. Also from first statement, 1 sheep will eat

$$\frac{1}{8}\frac{1}{10}(\frac{9}{x + 2\frac{8}{7}} + 9u) = \frac{3}{8}\frac{1}{10}(\frac{7}{7x + 20} + u) \dots (6)$$

Now 3 oxen = 5 colts = 140 sheep.

From (1) and (5), $11x(25 + 18ut) = 252t(1 + ux) \dots (7)$.

From (5) and (6), $7ux^2 + 20ux + 7x = 200 \dots (8)$.

From (4), $65 = 54tu$, or $u = 65/54t$. (7) becomes, by substituting u , $5x = 6t$, or $t = 5x/6$.

$\therefore u = 13/9x$. This in (8) gives $x = 10$ weeks.

$\therefore u = \frac{1}{9}\frac{13}{10}$, $t = \frac{2}{3}\frac{5}{10}$.

From (1), 1 ox eats in 1 week, $\frac{7}{4}\frac{1}{5}$;

From (2), 1 colt eats in 1 week, $\frac{7}{7}\frac{1}{5}$;

From (5), 1 sheep eats in 1 week, $\frac{1}{3}\frac{1}{10}$.

$\frac{7}{4}\frac{1}{5} + \frac{7}{7}\frac{1}{5} + \frac{1}{3}\frac{1}{10} = \frac{2}{3}\frac{2}{10}$, what 1 ox, 1 colt and 1 sheep eat in 1 week.

The grass on 1 acre in 1 week with what grows $= 1 + \frac{1}{9} = \frac{10}{9}$.
 $\frac{2}{9} - \frac{1}{9} = \frac{1}{9}$, the amount of the standing grass eaten in 1 week.
 $1 \div \frac{1}{9} = 9$ weeks, the time required.

SOME INTERESTING RULES IN MULTIPLICATION.

BY MARY M. CURRIER, WENTWORTH, N. H.

RULE 1. To multiply one number by another, the multiplier consisting of two digits of which the left-hand digit is 1:

Multiply each figure of the multiplicand by the right-hand figure of the multiplier, and to each product add the figure of the multiplicand following the one multiplied.

Example 1. Multiply 1675 by 13.

$$\begin{array}{r} 1675 \times 13 = 21775 \\ 5 \times 3 = 15 \\ 7 \times 3 = 21, \quad 21 + 1 + 5 = 27 \\ 6 \times 3 = 18, \quad 18 + 2 + 7 = 27 \\ 1 \times 3 = 3, \quad 3 + 2 + 6 = 11 \\ \quad \quad \quad 1 + 1 = 2 \end{array}$$

Taking the digits in the units place in these several products beginning with the last, we have, $21775 = 13 \times 1675$.

Example 2. Multiply 40928 by 17.

$$\begin{array}{r} 8 \times 7 = 56 \\ 2 \times 7 = 14, \quad 14 + 5 + 8 = 27 \\ 9 \times 7 = 63, \quad 63 + 2 + 2 = 67 \\ 0 \times 7 = 0, \quad 0 + 6 + 9 = 15 \\ 4 \times 7 = 28, \quad 28 + 1 + 0 = 29 \\ \quad \quad \quad 2 + 4 = 6 \end{array}$$

$\therefore 695776 = 17 \times 40928$.

RULE 2. To multiply one number by another, the multiplier consisting of three digits, of which the two at the left are ones:

Multiply each figure of the multiplicand by the right hand figure of the multiplier and to each product add the two figures following the one multiplied and the digit in the tens place of the preceding product.

Example 1. Multiply 340726 by 114.

$$\begin{array}{r} 6 \times 4 = 24 \\ 2 \times 4 = 8, \quad 8 + 2 + 6 = 16 \\ 7 \times 4 = 28, \quad 28 + 1 + 2 + 6 = 37 \\ 0 \times 4 = 0, \quad 0 + 3 + 7 + 2 = 12 \\ 4 \times 4 = 16, \quad 16 + 1 + 0 + 7 = 24 \\ 3 \times 4 = 12, \quad 12 + 2 + 4 + 0 = 18 \\ \quad \quad \quad 1 + 3 + 4 = 8 \\ \quad \quad \quad 3 = 3 \end{array}$$

$\therefore 38842764 = 114 \times 340726$.

RULE 3. To multiply one number by another, the multiplier consisting of two digits of which the left hand digit is 2.